Improvement of the fission channel in the EMPIRE II code

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Modeling of the fission channel in the EMPIRE-2.18 code was only adequate for heavy ion induced reactions. Version 2.19 (Lodi) of the code introduces an advanced fission formalism applicable also to the multi-chance fission induced by low energy nucleons.

Light particle induced fission proceeds through the formation of the compound nucleus treated in EMPIRE-II within Hauser-Feshbach and HRTW models. The expression for the fission probability, as used in the 2.19 version, is derived in the frame of the optical model for fission. It describes the transmission through a multi-humped barrier starting from the sub-barrier excitation energies. Using this generalized relation, it is possible to reproduce experimental fission cross sections (including the resonant structure observed in fertile nuclei) and to set up a general procedure for determining parameters describing fission barriers associated with the transition states.

In the first run EMPIRE automatically creates auxiliary input file with parameters describing discrete fission barriers and level densities at the saddle points. These values are taken from RIPL-2, from internal systematics, or are calculated by the code. For the level densities at the saddle points the HF-BCS results of RIPL-2 or the dynamical approach specific to EMPIRE (accounting for collective enhancements and nuclear shape asymmetry at each saddle) can be used. The user can easily modify fission related parameters by editing the existing input file.

Encouraging results indicate that improvement of the fission channel extends applicability of the EMPIRE code to the interaction of low energy neutrons with the actinides, which is of primary importance for various applications.

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